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Research Article

Living Alone, Cognitive Function, and Well-Being of Japanese Older Men and Women: A Cross-Sectional Study

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This study examined the interaction of living alone and cognitive decline in relation to the well-being of older men and women. We analyzed the data from a cross-sectional, self-administered questionnaire survey of community-dwelling older adults in Tokyo, who were aged 65+ and not on long-term care. The questionnaire included the 10-item self-administered dementia checklist (SDC), the WHO-5 Well-Being Scale, a question on their living arrangement, and participants' baseline characteristics and social support and social contact. The analyses were stratified by sex and fitted with linear regression models with interaction. A total of 34,255 men and 41,056 women participated. Sample mean age was 73.5 (SD 6.1) for men and 73.6 (SD 6.0) for women, and 18.5% and 26.0% lived alone. The distribution of SDC scores indicated 95.9% and 97.0% had a cognitive status varying from intact to possible mild dementia. Cognitive decline showed a linear association with lower well-being in men (beta -0.53; 95% CI -0.58, -0.48; $p < 0.001$) and women (beta -0.38; 95% CI -0.42, -0.34; $p < 0.001$). Compared to men and women living with others, those living alone experienced lower well-being as their cognitive function declined, and the interactions (living arrangements ∗ SDC) were statistically significant. After controlling participants' characteristics and social support and social contact, the interaction was significant in men ($p < 0.001$) but not in women ($p = 0.46$). Our findings support that older men and women living alone experience a slightly steeper downward trajectory of cognitive decline and poor well-being than their counterparts living with others. The unequivocal effects of controlling confounding factors between men and women indicate the need for gendered countermeasures by welfare services.

1. Introduction

Among the issues in contemporary societal aging, the increasing prevalence of older adults living alone is one of the most objectively observable characteristics [1] and this trend is especially evident in major metropolitan areas in Japan [2]. In Tokyo, the prevalence of older adults (defined as aged 65 and over) living alone was 26.9% in 2020 and is projected to reach 29.2% in 2040 [3]. Although many factors contribute to this issue, one major factor is the modernization of social preferences towards more individualistic lifestyles and its corresponding impact on family structures, which are shifting away from the traditional multigenerational household [4].

Family values, like the notion of filial piety, heavily influenced traditional family systems to regard familial caregiving as the appropriate source of support for older members with physical or cognitive disabilities [5]. Japan's long-term care (LTC) system was conceptualized assuming that multigenerational households would continue to function as the primary means of caregiving and only outsource a fraction of the burden of care to the system [4] and was thus designed to provide mainly practical and instrumental support. In the LTC system, local municipalities as insurers take charge of system operation, and local welfare providers serve individual care to older adults aged 65 years or over (primary insured individuals) at home or in facilities. Their care levels are certified based on their

assessed care needs in five domains: physical care, household assistance, behavioral and psychological symptoms of dementia, rehabilitation, and medical care. Since the launch of the LTC system in 2000, the trend in older adults with solitary living arrangements reveals gaps in adequate support provision to this growing demography, which are less in terms of physical limitations but more in addressing emotional and social needs, especially in cases of declining cognitive function [4].

Living alone is a solitary living arrangement with no cohabitants, whose presence could provide some degree of emotional, instrumental, and informational domestic support. However, living alone in and of itself does not suggest that the individual is not well supported [6, 7]. For instance, the gender gap exists in the consequences of living alone, such as health status, met and unmet support needs, and well-being [8–10]. As Cantor's hierarchical-compensatory model of social supports explains [11], older adults living alone enjoy variable social interactions within their interpersonal relationships that act as a social resource to compensate for the lack of domestic support and contribute to their better well-being [12–14]. These interactions may range from weak, acquaintance-level social ties to strong, intimate personal relationships [12]. Burnette et al. [15] suggest that such social resources were particularly beneficial in urban settings to reduce the adversity of living alone on the overall well-being of older adults, although the degree of possession and utilization of such social resources may differ between sexes.

While research-to-date primarily focuses on specifying and addressing the factors which exacerbate or alleviate the reciprocal relationship between cognitive decline and well-being, we consider the impact that living alone introduces into this dynamic for older adults.

Although some older adults are well acclimated to solitary living, for others, the circumstances of living alone raise their susceptibility to both cognitive decline [16] and poor well-being [17], two conditions that affect each other reciprocally and may result in a downward spiral if not appropriately addressed [18–20]. When confronted with a gradual cognitive decline, an individual's support needs often rise. Consequently, the added condition of living alone may result in a higher risk of accelerating the deterioration of cognitive decline and well-being. However, the provision of social support resources may alleviate the risk factors related to solitary living [21].

These hypotheses warrant investigation for two practical reasons: First, the prevalence of living alone in older adults and the occurrence of cognitive decline, both generally increase with age and place the population at the combination of these two conditions at a higher risk of needing support [2, 22]. Second, living alone and cognitive decline are two known risk factors for social isolation, and their overlap may shape the individual's social behavior and perception of their social status.

Taken together, this suggests the growing population of older adults living alone are less likely to seek intervention for declining cognitive functions either from a lack of self-awareness due to suboptimal engagement with social support resources such as friends and family [23, 24] or from a lack of impetus or desire to seek help such as an early diagnosis [25] even if aware of their condition. This implies an increased likelihood that their needs will be overlooked and continue to be unmet, leading to a probable decline in overall well-being.

In regards to living alone, studies have shown the adversities of solitary living on the health and well-being of older adults [26]. However, gaps exist in the research record in considering compound factors such as the interaction between living alone and cognitive decline, which may highlight vulnerable or at-risk demographic groups who have been overlooked by current support systems.

A better understanding of the influence of living alone on the association between gradual cognitive decline and well-being can inform approaches for improving home-based LTC for community-dwelling older adults. To end this, this study used data from community-dwelling older men and women in Tokyo to confirm the association between cognitive decline and well-being and examine if the observed association was greater among those living alone.

2. Materials and Methods

2.1. Study Design. This is a secondary analysis of the cross-sectional data collected through a self-administered questionnaire survey conducted in a city ward in Tokyo in 2015. The survey was designed and executed in close collaboration with the welfare division of the ward office and served the dual purpose of giving the participants individual feedback on their health status and informing the reform of welfare services in the ward. This analysis was conducted with the intention of contributing to the latter.

2.2. Ethical Procedures. All materials and procedures were approved by the Ethical Committee of the Tokyo Metropolitan Institute of Gerontology (approval number 2014-98). Written information was enclosed with the survey, and written consent was obtained from all participants.

2.3. Setting. We conducted a postal, self-administered questionnaire survey in one of the city wards in the Tokyo Metropolitan area from June 2015 to August 2015. The ward is a residential area located in the peripheral part of the metropolitan area with a population of around 700,000, of which older adults aged 65+ accounted for 25%. The rates of population aging and older adults living alone in this ward were among the highest in the 23 wards in Tokyo.

2.4. Participants. All community-dwelling older residents aged 65+, who were not on LTC and lived in the ward at the survey time, were eligible for this study. Of 162,963 older adults living in the ward at the time of the survey, 132,005 qualified individuals received the survey and 78,917 responded (response rate: 59.8%) (Figure 1).
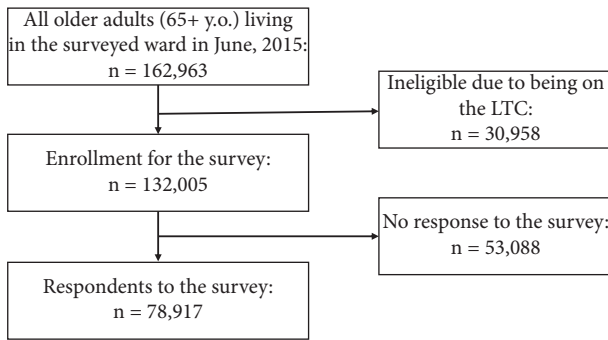
Figure 1: Flowchart of participants.

2.5. Variables

2.5.1. Dependent Variable.
The dependent variable was the simplified Japanese version of the WHO-5 Well-Being Index (S-WHO-5-J) [27]. The total score ranges from 0 to 15, with a higher score indicating better psychological well-being.

2.5.2. Independent Variable.
The independent variable was the 10-item self-administered dementia checklist (SDC). This was the only measurement that met the following two conditions: a measurement that was available in Japanese and was scientifically tested for use in self-administered surveys [28, 29]. The SDC requests participants to self-evaluate their daily functioning of memory and the basic and instrumental activities of daily living. The total score ranges from 10 to 40, with a lower score indicating a better cognitive function. The validation study of the SDC showed a moderate correlation with the Mini-Mental State Exam scores (correlation coefficient, 0.54), and the suggested cut-off score for possible dementia was 17/18 [28]. For the analyses in this study, we only used the data scored from 10 to 25 because the distribution of the score was highly skewed toward 10, with the mean being 12.5 and the 99-percentile score being 25. This distribution was analogous to that in the validation study [28, 29]. The skewness resulted in few numbers in each group with scores above 25 and severe fluctuations in the S-WHO-5-J scores. Thus, we regarded those who scored 26 or higher as outliers in this cohort and eliminated them from the analyses.

2.5.3. Covariates: Baseline Characteristics.
The baseline characteristics included age in years, sex, marital status, perceived economic status, years of education, year of current residence, number of comorbidities, motor function measured with the Motor Fitness Scale [30], and regular visits to a primary care physician (PCP). Marital status was measured by a single dichotomous question asking whether the participant is currently married. For the perceived economic status, we asked "how do you feel about the economic status of your current life?" and provided a 5-point Likert scale from very poor to excellent. The responses were dichotomized as good (fair, good, and excellent) or poor (poor and very poor) for the analyses. Regular visits to a PCP were also asked with a dichotomous question. The number of comorbidities was calculated from the answers to

a multiple-choice question asking about current and past medical history from the following list of diseases: hypertension, stroke, heart diseases, diabetes, hypercholesterolemia, cancer, musculoskeletal diseases, depression, dementia, and others.

2.5.4. Covariates: Social Support and Social Contact.
We examined the following variables of the participants: the reception of social support, provision of social support, regular visits to friends, regular participation in group activities, current employment status, and possession of neighborhood ties. These factors were chosen as indicators of the degree of social support and social contact, which are crucial aspects of the social resources available to an individual [12]. Complying with the city ward's motive for informing the welfare service reform, we did not include covariates for familial social support or contact, which typically depends on less modifiable family relationships.

The reception of social support was asked with a binary question of whether the participant has a person who provides support in the time of need. Similarly, the provision of social support was asked with a binary question of whether the participant has a person for whom the participant provides support when the person needs it. The next three variables, regular visits to friends, regular participation in group activities, and current employment status, were asked with dichotomous questions. For the group activity question, we provided examples including neighborhood community associations, senior clubs, hobby clubs, sports clubs, and volunteer groups. To assess possession of neighborhood ties, participants were asked about their relationships with neighbors with four response options: visiting each other, stand-chatting, saying hello, and not interacting. We comprehended the first two response options indicating possession of meaningful neighborhood ties and dichotomized the answers as such for the analyses.

2.6. Statistical Analyses.
Descriptive statistics were stratified by sex and shown by means, standard deviation (SD), and percentages. These descriptive data were compared by living arrangements using chi-squared test for categorical variables and two-sample t-test for numerical variables.

To determine if the association between cognitive impairment and well-being was moderated by living arrangements, we initially tested the significance of the interaction term (living arrangements * SDC) on S-WHO-5-J in sex-stratified linear regression analyses. The significance of the interaction was confirmed in both sexes; hence, in the rest of the analyses, we stratified the analyses by sex and examined the differences between those living alone and those living with others.

The association between SDC and S-WHO-5-J was examined by hierarchical linear regression analyses: crude, adjusted-1 (controlling the baseline characteristics), and adjusted-2 (controlling the baseline characteristics and social status) models. We conducted simple slope analyses in each model to examine the significance of the differences in slopes between those living alone and those living with

others. Cases with missing data were omitted from each analysis (i.e., complete-case analysis). All the analyses were interpreted with the level of significance set at $p < 0.05$ and computed using IBM SPSS Statistics v.28.

3. Results

3.1. Participants' Baseline Characteristics and Social Status. Of 78,917 collected responses out of 132,005 eligible individuals (response rate 59.8%), 75,311 responses, 34,255 (45.4%) male and 41,056 (54.5%) female respondents, were valid and analyzed. The prevalence of living alone was 18.5% and 26.0%, respectively. Table 1 shows the participants' baseline characteristics, social support and social contact, SDC scores, and well-being scores of men and women, who live alone and with others.

Men and women differed in several characteristics between those living alone and those living with others. On aggregate, men living alone were slightly younger (72.7 (SD 6.0) vs. 73.8 (SD 6.1), $p < 0.001$), less likely to be currently married (8.3% vs. 92.7%, $p < 0.001$), and less likely to regularly visit a PCP (84.9% vs. 91.4%, $p < 0.001$). In contrast, women living alone were slightly older (75.2 (SD 6.0) vs. 73.3 (SD 5.8), $p < 0.001$), likely to be currently married (3.7% vs. 74.4%, $p < 0.001$), and similar in the rate of regular visits to a PCP (92.3% vs. 93.3%, $p < 0.001$).

Regarding social status, two general tendencies emerged: men had less favorable social status compared to women, and those living alone had less favorable social status compared to those living with others. When looking closer at the degree of differences between those living alone and those living with others, there were two gender gaps noticeable. First, the deltas in percentages by living arrangements of reception and provision of social support and possession of neighborhood ties are larger in men than in women. For example, the delta in the percentages of reception of social support was −14 for men (67.9% vs. 81.9%, $p < 0.001$), but only −3.5 for women (88.6% vs. 92.1%, $p < 0.001$). Second, there was a tendency observed that men living alone were less likely to engage in regular visits to friends (38.0% vs. 40.2%, $p < 0.001$) or group activities (37.5% vs. 50.0%, $p < 0.001$) than their counterparts; however, in women, the numbers were almost identical (58.3% vs. 57.0%, $p = 0.066$, and 55.8% vs. 55.3%, $p = 0.43$, respectively).

3.2. The Interaction of SDC and Living Arrangements against S-WHO-5-J. We first confirmed the significance of the interaction between SDC and living arrangements against S-WHO-5-J. Figure 2 visualizes the association between SDC and S-WHO-5-J of each group, and Tables 2 and 3 show the summary statistics of the sex-stratified linear regression models with the interaction term. Cognitive decline showed a significant linear association with lower well-being in men (beta −0.53; 95% C.I. −0.58, −0.48; $p < 0.001$) and women (beta −0.38; 95% C.I. −0.42, −0.34; $p < 0.001$) in the crude models. For both sexes, those living alone had a slightly steeper slope than those living with others, and the interactions (living arrangements*SDC) were statistically significant in the crude models ($p < 0.001$ for men, $p = 0.012$ for women).

3.3. Comparisons of Slopes by Living Arrangements. Figure 3 depicts the results of the simple slope analyses that tested the significance of the differences in slopes by living arrangements. In men, the slopes significantly diverged in the crude model (estimates −1.11; 95% C.I. −1.45, −0.77; $p < 0.001$), the adjusted-1 model (−1.14; 95% C.I. −1.51, −0.71; $p < 0.001$), and even after adjusting for the social factors in the adjusted-2 model (−0.99, 95% C.I −1.36, −0.62; $p < 0.001$). In contrast, in women, the difference in slopes observed in the crude model (−0.39; 95% C.I. −0.70, −0.09; $p = 0.012$) was no longer significant in the adjusted-1 model (−0.11; 95% C.I. −0.45, 0.22; $p = 0.51$) or adjusted-2 model (−0.13, 95% C.I. −0.46, 0.21; $p = 0.46$).

4. Discussion

This study examined the interaction of common coexisting conditions of living alone and gradual cognitive decline in relation to the well-being of older men and women. Living alone was associated with a slightly steeper slope between declining cognitive function and lowering well-being, particularly in men. Compared to those living with others, men who lived alone tended to possess fewer social support and social contact, and even after controlling their social support and social contact, the interaction was significant.

4.1. Interaction of Living Alone and Gradual Cognitive Decline against Well-Being. The results suggest that the social support needs of those living alone with cognitive decline are addressed to a lesser degree than those living with others. The hierarchical analyses illustrate that the differences in slopes narrowed after controlling for baseline characteristics and social status. This supports findings from preceding studies that the adverse effects of living alone are attributable to the absence of a spouse [9, 31] and inadequate social resources due to social isolation [17, 23, 32].

However, after controlling for social resources, the differential slope for men living alone remains significant, suggesting that the adversity of living alone is only partially resolved. This difference in slopes may indicate the effect of unmeasured personal aspects, such as emotional distress related to living alone (e.g., loneliness) [32, 33]. Loneliness is an undesirable subjective experience related to unfulfilled, intimate, and meaningful connection [34]. The social support and social contact variables in our study measured the exchange of nonspecific social support (may or may not count emotional support) and frequencies and breadth of social interaction and, hence, may not capture participants' perceptions relating to their social participation.

4.2. Reasons for the Gender Gap in the Interaction. Observing the difference in results by gender, older men living alone are more susceptible to cognitive decline and consequently poorer well-being than women under the same conditions, providing support and explanation for the comparable findings in recent studies from Japan and the U.S. showing that living alone unequally affected men's

TABLE 1: Baseline characteristics, social support and social contact, and independent and dependent variables.

	Men: $n = 34,255$			Women: $n = 41,056$		
	Live alone, $n = 6,338$	Live with others, $n = 27,917$	p value	Live alone, $n = 10,659$	Live with others, $n = 30,397$	p value
Age in years, mean (SD)	72.7 (6.0)	73.8 (6.1)	<0.001	75.2 (6.0)	73.3 (5.8)	<0.001
Married, n (%)	479 (8.3%)	24630 (92.7%)	<0.001	357 (3.7%)	21651 (74.4%)	<0.001
Perceived economic status, good, n (%)	4884 (90.3%)	21,772 (88.5%)	<0.001	8,568 (90.2%)	24,158 (88.2%)	<0.001
Years of education, mean (SD)	11.4 (3.1)	11.7 (3.0)	<0.001	10.8 (2.5)	11.1 (2.3)	<0.001
Years of current residence, mean (SD)	24.4 (19.5)	35.5 (18.9)	<0.001	30.2 (18.5)	34.6 (17.3)	<0.001
Numbers of comorbidities, mean (SD)	1.4 (1.1)	1.4 (1.1)	0.006	1.5 (1.2)	1.5 (1.1)	<0.001
Motor function scale (0–14), mean (SD)	10.6 (3.3)	11.1 (3.2)	<0.001	9.9 (3.8)	10.5 (3.6)	<0.001
Regular appointments with primary care physician, n (%)	5,023 (84.9%)	24,341 (91.4%)	<0.001	9,389 (92.3%)	27,345 (93.3%)	<0.001
Reception of social support from others, n (%)	4,051 (67.9%)	21,954 (81.9%)	<0.001	9,069 (88.6%)	27,118 (92.1%)	<0.001
Provision of social support for others, n (%)	3,406 (57.5%)	20,409 (76.6%)	<0.001	7,765 (77.2%)	24,457 (84.0%)	<0.001
Possession of neighborhood ties, n (%)	2,338 (41.2%)	13,653 (52.7%)	<0.001	7,132 (74.0%)	21,894 (77.6%)	0.066
Regular visits to friends, n (%)	2,181 (38.0%)	10,509 (40.2%)	<0.001	5,779 (58.3%)	16,307 (57.0%)	0.066
Regular participation in group activities, n (%)	2,374 (37.5%)	13,955 (50.0%)	<0.001	5,944 (55.8%)	16,802 (55.3%)	0.43
Currently employed, n (%)	1,815 (31.4%)	12,077 (45.6%)	<0.001	2,403 (24.4%)	10,429 (35.9%)	<0.001
Self-administered dementia checklist (10–40), mean (SD)	12.4 (2.8)	12.8 (3.2)	<0.001	12.5 (2.7)	12.5 (2.9)	0.21
WHO-5 Well-Being Index (0–15), mean (SD)	9.1 (3.8)	10.2 (3.4)	<0.001	9.9 (3.6)	10.1 (3.5)	<0.001

p values were calculated from chi-squared test for categorical variables and two-sample t-test for numerical variables.
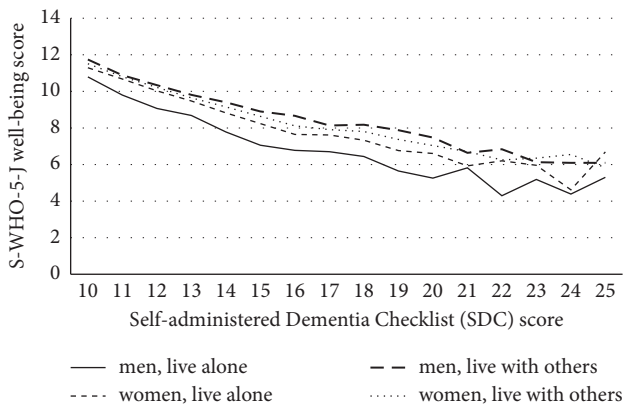

FIGURE 2: Association between cognitive function and well-being by sex and living arrangements.

health status [31, 35]. A possible cause may be the gendered behaviors of seeking and receiving support in nonspousal relationships. Men generally assimilate the socialized gender role of being strong and independent and, therefore when faced with cognitive decline, may assume social behaviors aimed towards hiding their perceived weakness even to the point of social isolation. In older men, intimate relationships are often limited to their spouse, while older women rely on a more diverse set of relationships such as their children and social relationships in their community [36]. On the other hand, older women, especially those living alone, tend to be concerned about the future state of their living conditions and potentially shrinking social networks and therefore may develop preventive behaviors

such as socializing in the community and nurturing meaningful social relationships. Such behaviors are beneficial for developing vital social resources for maintaining their sense of well-being.

4.3. Need for Gendered Approaches. In response to the emerging trends of solitary living among older adults, current welfare practices typically leverage community-based social activities as a means of providing equal opportunities to minimize social isolation and promote the well-being of men and women. However, a recent systematic review analyzed 39 studies that tested the effect of social connectedness intervention and found 86.4% of attendees were female, suggesting that the disproportionate representation of women may skew the activities towards more female-oriented ones [37]. The value of social activity services to enhance health holds equally true for both genders [37, 38], however, older men are less likely to be the beneficiaries of such services [38, 39]. A gendered approach towards developing social activity content that meets their respective social preferences will enhance participation and social benefit.

Our results suggest that even when controlled for the provision of social resources, the adversity of living alone is not fully mitigated and therefore additional support services may be required. These may include individualized support structures such as helplines or a combination of food preparation and dinner partners to satisfy these residual needs [8]. The latter may be arranged by LTC providers alone or in collaboration (in the arrangement of dinner partners in particular) with informal, nonprofit organizations in the community.

Table 2: Beta coefficients for men's S-WHO-5-J scores in crude, adjusted-1, and adjusted-2 models.

	Crude model			Adjusted-1 model			Adjusted-2 model		
	Beta	95% C.I.	p value	Beta	95% C.I.	p value	Beta	95% C.I.	p value
SDC	−0.53	−0.58, −0.48	<0.001	−0.44	−0.49, −0.38	<0.001	−0.40	−0.45, −0.34	<0.001
Living arrangements	−0.018	−0.065, 0.030	0.47	−0.097	−0.15, −0.043	<0.001	−0.10	−0.16, −0.047	<0.001
SDC*living arrangements	0.23	0.16, 0.30	<0.001	0.23	0.15, 0.31	<0.001	0.22	0.14, 0.29	<0.001

SDC, self-administered dementia checklist. Adjusted-1 model controlled baseline characteristics including age, marital status, perceived economic status, education, year of current residence, comorbidities, motor function, and regular visits to a primary care physician. Adjusted-2 model controlled the baseline characteristics and social status including reception of social support, provision of social support, regular visits to friends, regular participation in group activities, current employment status, and possession of neighborhood ties.

Table 3: Beta coefficients for women's S-WHO-5-J scores in crude, adjusted-1, and adjusted-2 models.

	Crude model			Adjusted-1 model			Adjusted-2 model		
	Beta	95% CI	p value	Beta	95% CI	p value	Beta	95% CI	p value
SDC	−0.38	−0.42, −0.34	<0.001	−0.27	−0.31, −0.23	<0.001	−0.24	−0.28, −0.19	<0.001
Living arrangements	−0.032	−0.080, 0.016	0.20	0.019	−0.035, 0.072	0.50	0.018	−0.036, 0.072	0.51
SDC*living arrangements	0.078	0.018, 0.14	0.012	0.021	−0.046, 0.087	0.54	0.016	−0.052, 0.083	0.65

SDC, self-administered dementia checklist. Adjusted-1 model controlled baseline characteristics including age, marital status, perceived economic status, education, year of current residence, comorbidities, motor function, and regular visits to a primary care physician. Adjusted-2 model controlled the baseline characteristics and social status including reception of social support, provision of social support, regular visits to friends, regular participation in group activities, current employment status, and possession of neighborhood ties.
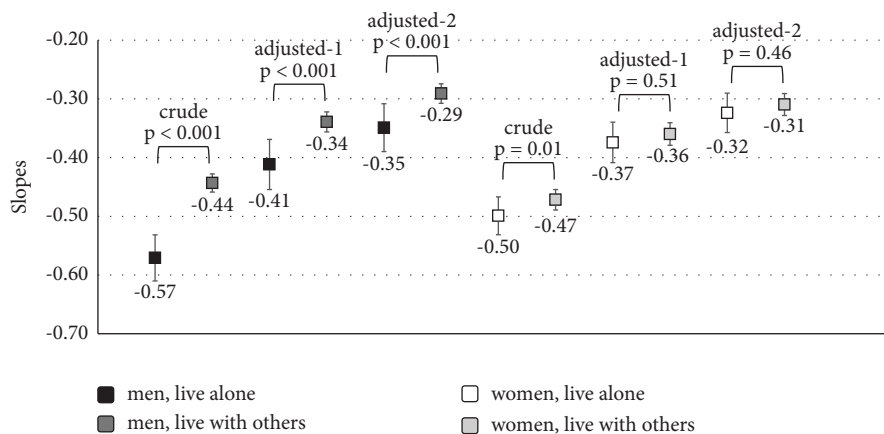

Figure 3: Comparisons of slopes by living arrangements. The box and the number indicate the slopes and the error bars indicate the 95% confidence intervals of each slope. p values are computed with simple slope analyses in each model. Adjusted-1 model controls baseline characteristics and adjusted-2 model controls baseline characteristics and social status.

4.4. Implication. Our results illustrate the connection between living alone and cognitive decline and its impact on the well-being aspect of overall health. This study calls for further research to better understand the impact of the dual adversities of living alone and cognitive decline on different health outcomes from different research perspectives. To the welfare sectors that design community services for older adults living alone, this study provides additional evidence of gender gaps and their implications for living alone. Welfare sectors should consider such gendered approaches to their design of support services in order to maximize their reach and benefit to the target community.

4.5. Limitations. The study has three limitations in its methods that require attention when interpreting the results. Firstly, cognitive function was assessed with a proxy measurement, SDC, in a self-administered questionnaire survey. Since some participants may have had cognitive impairment that inhibited precise comprehension of their own functioning [40], this may have caused imprecision in the assessment. Secondly, the social resources were not evaluated with a validated tool, which may have also led to imprecision. However, the questions that we used for the assessment of social resources were carefully worded and commonly employed in public health surveys for older adults in Japan. Lastly, the data

collection was conducted in one area of Tokyo, which can pose a potential bias on the study sample and limit the generalizability of the results.

In addition to these methodological limitations, the potential impact of the COVID-19 pandemic on the interpretation of this research should be addressed. The preventive strategies against the pandemic universally enforced social distancing, which has been affecting the public perceptions and behaviors regarding social isolation and social participation [41]. One of the salient examples is the awareness and adoption of technologies, such as videoconferencing applications, as effective tools for social participation among older adults [42]. Because this study analyzed prepandemic data at a single time point, such a swing was not reflected.

5. Conclusion

Our findings suggest that older men and women living alone in an urban area experience a slightly steeper downward trajectory of cognitive decline and poor well-being than their counterparts living with others. In older women, those living alone enjoyed a similar level of social resource support as those living with others through communal social relationships, which mitigated some of the risk factors from living alone. However, in men, those living alone exhibited the lowest levels of social resource support, suggesting the vulnerability of this particular group.

These results highlight the importance of welfare services that cater to the different characteristics and needs of older men and women living alone with gradual cognitive decline. Such gendered approaches may be necessary to produce an effective strategy for enhancing individual social resources, and additional layers of support may be needed to equalize levels of well-being in older men living alone.

Data Availability

The data used to support the findings of this study have not been made available because of the privacy protection policy of the city ward office that funded this survey.

Ethical Approval

All materials and procedures were approved by the Ethical Committee of the Tokyo Metropolitan Institute of Gerontology (approval number: 2014-98).

Consent

Written information was enclosed with the survey, and written consent was obtained from all participants.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

Acknowledgments

References

[1] D. Reher and M. Requena, "Living alone in later life: a global perspective," *Population and Development Review*, vol. 44, no. 3, pp. 427–454, 2018.

[2] Ministry of Health Labour and Welfare of Japan, *Comprehensive Survey of Living Conditions*, MHLW, Tokyo, Japan, 2019.

[3] National Institute of Population and Social Security Research, "Household projections for Japan 2015–2040," 2018, https://www.ipss.go.jp/pp-ajsetai/j/HPRJ2018/houkoku/hprj2018_houkoku.pdf.

[4] S. Tanaka, *The Community-Based Integrated Care System in a Pluralistic Society*, Mitsubishi UFJ Research and Consulting Co., Ltd, Tokyo, Japan, 2019.

[5] E. Takagi and Y. Saito, "A longitudinal analysis of the impact of family support on the morale of older parents in Japan: does the parent's normative belief in filial responsibilities make a difference?" *Ageing and Society*, vol. 33, no. 6, pp. 1053–1076, 2013.

[6] D. Russell and J. Taylor, "Living alone and depressive symptoms: the influence of gender, physical disability, and social support among hispanic and non-hispanic older adults," *Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, vol. 64B, no. 1, pp. 95–104, 2009.

[7] K. A. Renwick, C. Sanmartin, K. Dasgupta, L. Berrang-Ford, and N. Ross, "The influence of low social support and living alone on premature mortality among aging Canadians," *Canadian Journal of Public Health*, vol. 111, no. 4, pp. 594–605, 2020.

[8] H. Ko, Y. H. Park, B. Cho et al., "Gender differences in health status, quality of life, and community service needs of older adults living alone," *Archives of Gerontology and Geriatrics*, vol. 83, pp. 239–245, 2019.

[9] C. Henning-Smith, "Quality of life and psychological distress among older adults: the role of living arrangements," *Journal of Applied Gerontology*, vol. 35, no. 1, pp. 39–61, 2016.

[10] H. S. Chu, J. Oh, and K. Lee, "The relationship between living arrangements and sleep quality in older adults: gender differences," *International Journal of Environmental Research and Public Health*, vol. 19, no. 7, p. 3893, 2022.

[11] M. H. Cantor, "Neighbors and friends: an overlooked resource in the informal support system," *Research on Aging*, vol. 1, no. 4, pp. 434–463, 2016.

[12] I. Kawachi and L. F. Berkman, "Social capital, social cohesion, and health," in *Social Epidemiology*, L. F. Berkman, I. Kawachi, and M. M. Glymour, Eds., Oxford University Press, Oxford, UK, 2014.

[13] A. Ehsan, H. S. Klaas, A. Bastianen, and D. Spini, "Social capital and health: a systematic review of systematic reviews," *SSM—Population Health*, vol. 8, Article ID 100425, 2019.

[14] C. M. Perissinotto and K. E. Covinsky, "Living alone, socially isolated or lonely-what are we measuring?" *Journal of General Internal Medicine*, vol. 29, no. 11, pp. 1429–1431, 2014.

[15] D. Burnette, X. Ye, Z. Cheng, and H. Ruan, "Living alone, social cohesion, and quality of life among older adults in rural

and urban China: a conditional process analysis," *International Psychogeriatrics*, vol. 33, no. 5, pp. 469–479, 2021.

[16] R. Desai, A. John, J. Stott, and G. Charlesworth, "Living alone and risk of dementia: a systematic review and meta-analysis," *Ageing Research Reviews*, vol. 62, Article ID 101122, 2020.

[17] K. J. Smith and C. Victor, "Typologies of loneliness, living alone and social isolation, and their associations with physical and mental health," *Ageing and Society*, vol. 39, no. 8, pp. 1709–1730, 2019.

[18] R. S. Wilson, P. A. Boyle, E. Segawa et al., "The influence of cognitive decline on well-being in old age," *Psychology and Aging*, vol. 28, no. 2, pp. 304–313, 2013.

[19] M. Allerhand, C. R. Gale, and I. J. Deary, "The dynamic relationship between cognitive function and positive well-being in older people: a prospective study using the english longitudinal study of aging," *Psychology and Aging*, vol. 29, no. 2, pp. 306–318, 2014.

[20] J. Zhang, L. W. Li, and S. J. McLaughlin, "Psychological well-being and cognitive function among older adults in China: a population-based longitudinal study," *Journal of Aging and Health*, vol. 34, no. 2, pp. 173–183, 2022.

[21] S. J. Shah, M. C. Fang, S. R. Wannier, M. A. Steinman, and K. E. Covinsky, "Association of social support with functional outcomes in older adults who live alone," *JAMA Internal Medicine*, vol. 182, no. 1, pp. 26–32, 2022.

[22] T. Ninomiya, Y. Kiyohara, T. Obara, and K. Yonemoto, "Estimated population of older adults with dementia in Japan," 2015, https://mhlw-grants.niph.go.jp/niph/search/NIDD00.do?resrchNum=201405037A.

[23] N. J. Donovan and D. Blazer, "Social isolation and loneliness in older adults: review and commentary of a national academies report," *American Journal of Geriatric Psychiatry*, vol. 28, no. 12, pp. 1233–1244, 2020.

[24] I. E. M. Evans, A. Martyr, R. Collins, C. Brayne, and L. Clare, "Social isolation and cognitive function in later life: a systematic review and meta-analysis," *Journal of Alzheimer's Disease*, vol. 70, no. s1, pp. S119–S144, 2019.

[25] N. L. Hill, E. Bratlee-Whitaker, A. Sillner, L. Brautigam, and J. Mogle, "Help-seeking for cognitive problems in older adults without dementia: a systematic review," *International Journal of Nursing Studies Advances*, vol. 3, Article ID 100050, 2021.

[26] *Social Isolation and Loneliness Among Older Poeple: Advocacy Brief*, World Health Organization, Geneva, Switzerland, 2021.

[27] H. Inagaki, K. Ito, N. Sakuma, M. Sugiyama, T. Okamura, and S. Awata, "Reliability and validity of the simplified Japanese version of the WHO-five well-being index (S-WHO-5-J)," *Nihon Koshu Eisei Zasshi*, vol. 60, no. 5, pp. 294–301, 2013.

[28] F. Miyamae, C. Ura, N. Sakuma et al., "The development of a self-administered dementia checklist: the examination of concurrent validity and discriminant validity," *Nippon Ronen Igakkai Zasshi. Japanese Journal of Geriatrics*, vol. 53, no. 4, pp. 354–362, 2016.

[29] C. Ura, F. Miyamae, N. Sakuma et al., "Development of a self-administered dementia checklist (SDC) (1): examination of factorial validity and internal reliability," *Nippon Ronen Igakkai Zasshi. Japanese Journal of Geriatrics*, vol. 52, no. 3, pp. 243–253, 2015.

[30] T. Kinugasa and H. Nagasaki, "Reliability and validity of the motor fitness scale for older adults in the community," *Aging Clinical and Experimental Research*, vol. 10, no. 4, pp. 295–302, 1998.

[31] T. Saito, C. Murata, J. Aida, and K. Kondo, "Cohort study on living arrangements of older men and women and risk for basic activities of daily living disability: findings from the AGES project," *BMC Geriatrics*, vol. 17, no. 1, p. 183, 2017.

[32] J. Holt-Lunstad, T. B. Smith, M. Baker, T. Harris, and D. Stephenson, "Loneliness and social isolation as risk factors for mortality: a meta-analytic review," *Perspectives on Psychological Science*, vol. 10, no. 2, pp. 227–237, 2015.

[33] B. Fátima, C. Cláudia, V. Gina, and D. M. Alice, "The impact of living alone on physical and mental health: does loneliness matter?" in *Health and Socio-Economic Status over the Life Course*, pp. 243–248, De Gruyter Oldenbourg, Berlin, Germany, 2019.

[34] T. Prohaska, V. Burholt, A. Burns et al., "Consensus statement: loneliness in older adults, the 21st century social determinant of health?" *BMJ Open*, vol. 10, no. 8, Article ID e034967, 2020.

[35] C. J. Nilsson, R. Lund, and K. Avlund, "Cohabitation status and onset of disability among older danes: is social participation a possible mediator?" *Journal of Aging and Health*, vol. 20, no. 2, pp. 235–253, 2008.

[36] T. C. Antonucci and H. Akiyama, "Social networks in adult life and a preliminary examination of the convoy model," *Journal of Gerontology*, vol. 42, no. 5, pp. 519–527, 1987.

[37] H. M. O'Rourke, L. Collins, and S. Sidani, "Interventions to address social connectedness and loneliness for older adults: a scoping review," *BMC Geriatrics*, vol. 18, no. 1, p. 214, 2018.

[38] C. Milligan, C. Dowrick, S. Payne et al., "Men's sheds and other gendered interventions for older men: improving health and wellbeing through social activity," 2013, https://envejecimiento.csic.es/documentos/documentos/lancaster-ac-uk-men-in-sheds2013-02-2015.pdf.

[39] R. Takashima, R. Onishi, K. Saeki, and M. Hirano, "The values and meanings of social activities for older urban men after retirement," *PLoS One*, vol. 15, no. 11, Article ID e0242859, 2020.

[40] L. Clare, I. Markova, F. Verhey, and G. Kenny, "Awareness in dementia: a review of assessment methods and measures," *Aging & Mental Health*, vol. 9, no. 5, pp. 394–413, 2005.

[41] K. Sayin Kasar and E. Karaman, "Life in lockdown: social isolation, loneliness and quality of life in the elderly during the COVID-19 pandemic: a scoping review," *Geriatric Nursing*, vol. 42, no. 5, pp. 1222–1229, 2021.

[42] J. W. Jutai and J. R. Tuazon, "The role of assistive technology in addressing social isolation, loneliness and health inequities among older adults during the COVID-19 pandemic," *Disability and Rehabilitation: Assistive Technology*, vol. 17, no. 3, pp. 248–259, 2022.